

SPECIAL REPORT FROM:

**GOVERNING**  
INSTITUTE

# MODERNIZING AMERICA'S INFRASTRUCTURE



A SUPPLEMENT TO GOVERNING









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# INTRODUCTION

Infrastructure makes everyday life possible. It allows us to make our daily commutes, have light when we flip a switch and get water from our faucets. Most of us take for granted that infrastructure will serve our needs.

But the nation's infrastructure is crumbling after years of neglect. Failure to fix it will cause far more than an inconvenience; it will have devastating human, economic and environmental impacts. Adding to the challenge is that the future won't look like either the past or the present. It will take careful planning to anticipate the impact of new technologies on how Americans live. Climate change intensifies these problems, as aging roads, transit systems, water plants and energy infrastructure face weather events more severe than they were designed to withstand.

Overcoming these hurdles will be expensive. While studies show that every dollar invested prevents \$15 in recovery costs, coming up with the cash is

daunting as the American Society of Civil Engineers (ASCE) estimates it will take \$2 trillion over a decade to close the investment gap.<sup>1</sup> But failure to respond would be even worse, since delay only creates much higher costs as assets fall further into disrepair.

In early 2018, the Governing Institute surveyed 146 employees of infrastructure-related state and local government agencies.<sup>2</sup> Funding was clearly their top concern, but the results also provide insight into what people on the front lines see as their biggest infrastructure challenges and what they are doing to address them. Results from the survey will be included throughout this report.

Despite the challenges, there is good news. Awareness of the problem is growing, and states and localities can take advantage of promising new strategies, emerging technologies and innovative financing ideas to solve these problems. The time to begin is long overdue.



# CLOSING THE NATION'S INFRASTRUCTURE INVESTMENT GAP IS KEY TO CONTINUED ECONOMIC GROWTH

The American Society of Civil Engineers' (ASCE) 2017 Infrastructure Report Card grades the nation's infrastructure a "D+," and estimates the U.S. needs to invest an additional \$2 trillion in infrastructure – from all levels of government.

After a generation of under investing in our nation's roads, bridges, drinking water systems, dams, levees and electric grid, our nation's infrastructure bill is overdue. It's time to reverse this trend. Our economic growth depends on it. It is estimated the average American family loses \$3,400 a year from unreliable, inefficient infrastructure such as leaky pipes, potholes and the occasional blackout.

Reversing this trend is possible if Congress, states, infrastructure owners and voters commit to increasing our investment. To close the \$2 trillion, 10-year investment gap, meet future needs and restore our global competitive advantage, we must increase investment from all levels of government and the private sector from 2.5 percent to 3.5 percent of U.S. gross domestic product by 2025. Two trillion is a daunting number, and while funding is an essential part of modernizing our nation's infrastructure, planning and executing

projects more efficiently can increase the value and capacity of infrastructure as well. For example, life cycle cost analysis increases and optimizes infrastructure investments by transforming the way we plan, deliver, operate and maintain infrastructure. This is done by considering the cost of a project through its entire lifespan before the project begins.

The biggest funding challenge we face is in transportation. While most of the 16 categories of infrastructure assessed in the Report Card face inadequate funding, surface transportation – roads, bridges and transit – account for half of that investment gap.

Historically, these transportation systems have been funded through the federal Highway Trust Fund (HTF), which is heading toward insolvency. Without action by 2021, the HTF's 18.4 cents per gallon tax on gasoline and 24.4 cents per gallon tax on diesel fuel will be woefully inadequate to support the program as has been the standard since the 1950s when the federal surface transportation program began. For the federal program to continue to be a trusted partner for the states, the motor fuels tax should be raised by at least 25 cents per gallon and future increases should be tied to inflation to restore its purchasing power, fill the funding deficit and ensure reliable funding for the future.

Securing the future solvency of the HTF will ensure the federal government can continue to be a strong investment partner. States and localities have been stepping up by increasing their own motor fuels taxes and voting for local ballot initiatives to address transportation challenges. Now it's the federal government's turn to do the same to achieve a transportation infrastructure system fit for the 21<sup>st</sup> century.

For more information, visit [InfrastructureReportCard.org](http://InfrastructureReportCard.org).



# UNDERSTANDING INFRASTRUCTURE'S IMPACT



**W**hen effectively deployed, infrastructure promotes public safety and prosperity and improves the quality of people's lives. The International Monetary Fund notes that infrastructure investment increases economic output in both the short and long term.<sup>3</sup>

But when infrastructure is inadequate or poorly maintained, the consequences to communities can be serious. Seventy-two percent of Governing Institute survey respondents said decay of public infrastructure assets negatively impacts residents in their jurisdictions. In extreme cases, decaying infrastructure can be deadly. In 2007, for instance, the rush hour collapse of an Interstate 35 bridge across the Mississippi River in Minneapolis left 13 people dead and 145 injured.

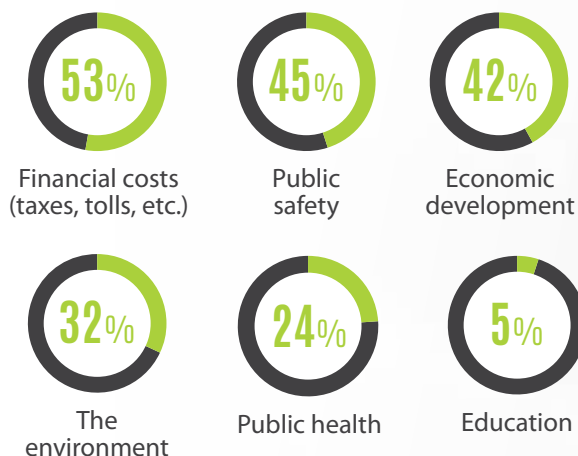
Inadequate infrastructure also has a financial impact. According to the ASCE 2017 Infrastructure Report Card, Americans spent 6.9 billion hours delayed in traffic, or 42 hours per driver, in 2014. The total cost of lost time and wasted fuel in that year alone was \$160 billion.<sup>4</sup>

In addition, ASCE estimates that 240,000 annual water main breaks between 2013 and 2020 will cost U.S. households \$59 billion and businesses \$147 billion (in 2010 dollars). Americans who have been reluctant to foot the bill for needed infrastructure upgrades often don't realize they're already paying. ASCE estimates that infrastructure shortfalls cost U.S. households \$3,400 annually.<sup>5</sup>

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Perhaps no recent event exemplifies the need for infrastructure investment more than the water crisis in Flint, Mich. In 2014, the city changed the source of its drinking water from Lake Huron and the Detroit River to the Flint River. Due to insufficient water treatment, lead leached from aging pipes into the water supply. A federal emergency was declared in January 2016. Since then, residents have used bottled water for drinking, cooking, cleaning and bathing. The consequences have been and will continue to be immense. Thousands of children with elevated lead levels may face future health problems and the long-term cost to the city is estimated to be at least \$400 million.<sup>6</sup> Flint's experience reminds us that in terms of both human costs and money, preventing problems is far less expensive than remediating them.

In what areas has your jurisdiction been negatively impacted by sub-par infrastructure?











# WHERE TO START & HOW TO TRIAGE

**W**hen then-Alaska Gov. Sarah Palin accepted the Republican nomination for vice president in 2008, one of the accomplishments she touted was putting the brakes on Alaska's "bridge to nowhere," which had received a \$223 million federal earmark. Cost estimates for the bridge, which would have connected the small city of Ketchikan to an island that housed its airport, rose to more than \$400 million. State officials are instead pursuing \$23 million in upgrades to ferry facilities for the 15-minute water commute.<sup>7</sup>

The episode highlighted systemic problems with public infrastructure project decision-making. Chief among them: Governments oftentimes fail to base project selection on data or to use the sophisticated forecasting tools private entities leverage to drive investment decisions.

There is certainly no shortage of deserving projects. In his 2018-19 budget proposal, California Gov. Jerry Brown estimated the funding backlog just to maintain existing infrastructure assets in his state at \$67 billion, a cost that nearly rivals California's pension and other post-employment benefit liabilities.<sup>8</sup>



“WE WANT TO CREATE AN ASSET MANAGEMENT CULTURE BY FACILITATING DATA COLLECTION THAT WILL ALLOW LOCAL OFFICIALS TO ARTICULATE CURRENT ASSET CONDITIONS, WHERE THEY WANT TO GET TO AND HOW THEY CAN GET THERE.”

- Therese Empie, Infrastructure Strategic Advisor,  
Office of Michigan Gov. Rick Snyder

But how can state and local governments choose among competing projects? How can they prioritize between the need to maintain existing assets and build new capacity? Following are some important strategies.

**Seek input from a diverse range of stakeholders.** Colorado's population is exploding, increasing from 3.3 million in 1991 to 5.5 million in 2015, with a projected population of 7.8 million by 2040.<sup>9</sup> To keep up with citizen needs, the state combines extensive use of data with human input from multiple stakeholders.

For example, each year the Colorado Department of Transportation (CDOT) convenes asset management leads and regional directors to report on the condition of assets and the resources needed to bring those assets to a state of good repair or other specified service level. The group votes on how best to allocate the available resources. CDOT also uses a parallel asset management process to allocate money between maintenance and capacity improvement on a four-year rolling cycle.

The state's transportation advisory committee, which includes representatives from every transportation region and metropolitan planning organization in the state, also meets monthly to inform CDOT about local priorities and help local stakeholders see their priorities in the context of statewide needs.

“Colorado relies on an integrated transportation system,” CDOT Executive Director Michael Lewis says. “It can't just be islands of prosperity in a sea of need.”

Local input helps CDOT assemble its 10-year development plan and has encouraged leaders to include features like widened road shoulders — which can be much safer for drivers who veer off the road — and climbing lanes in mountainous areas that serve high concentrations of tourists and recreational vehicles.

**Determine overall goals and priorities.** When you add up the road miles (1,800), bridges and bridge-like structures (more than 3,500) in northern Oklahoma's Grant County, the sum is greater than its population (4,500). Because Oklahoma's transportation funding is based on population, the county operates with a limited budget for infrastructure maintenance and investment.

Prioritization is key — and safety is the county's No. 1 priority. School bus routes are Grant County leaders' top concern, so transportation officials make sure all bridges on the routes have sufficient carrying capacity. While Grant County has 1,800 road miles, only 50 miles are blacktop; the rest are rock, shale and dirt. County leaders aim to ensure that everyone in the 1,000-square-mile area has some access to an all-weather road they can use to evacuate in the event of a flood.





# NAVIGATING THE FINANCIAL COMPLEXITIES OF INFRASTRUCTURE MODERNIZATION: 3 STEPS TO TAKE

The nation's infrastructure is in serious need of an upgrade. In a recent Governing Institute survey of 166 state and local leaders, nearly half (49%) said their transit infrastructures need to be modernized and 47 percent said the same of bridges.

But infrastructure modernization initiatives are often high risk and difficult to manage financially. Public sector organizations may not have the expertise or resources required, making it difficult to prevent fraud, waste, abuse and cost overruns.

Following are three key steps state and local governments can take to bring stringent financial management to infrastructure modernization.

## 1 IDENTIFY A TRUSTED OUTSIDE PARTNER.

An experienced, independent consulting firm can often take on the primary responsibility for managing financial integrity and project schedules. When problems arise that threaten cost overruns or the timely delivery of services, third-party consultants can draw on lessons learned from previous engagements to address the issues appropriately.

## 2 PERFORM A RISK ASSESSMENT.

A risk assessment — often conducted by an independent consultant — helps agencies identify the most likely problems on a job site and uncover any inadequacies in internal controls, expertise or any other oversight discipline. The assessment can then help officials optimize their oversight activities and available project resources.

## 3 CHOOSE THE RIGHT FUNDING VEHICLES.

States and localities have three main choices for infrastructure funding mechanisms: government funds, bonds and public-private partnerships (P3s). Choosing the best option — or combination of vehicles — requires expertise and careful analysis. To help make these determinations, leading independent consultants offer financial models honed during other large public sector projects and can help educate agencies on alternative approaches like P3s.



To learn more about how to improve your financial management practices before your next infrastructure modernization initiative, visit [www.cohnreznick.com/industries/public-sector/government](http://www.cohnreznick.com/industries/public-sector/government) and download the paper, "Bringing Stringent Financial Management to Infrastructure Modernization," at: [www.governing.com/infrastructurefinancing](http://www.governing.com/infrastructurefinancing)



Communities throughout the country are in a similar situation as Grant County and are relying on asset management plans to help them identify their most pressing needs. An asset management plan also helps leaders create routine maintenance schedules and identify the point at which it becomes more cost effective to replace rather than maintain an asset. According to the Governing Institute infrastructure survey, 78 percent of respondents reported their agencies have asset management plans.

**Invest in data that enables performance measurement.** Choosing the most deserving among competing projects remains a work in progress for most state and local governments. Improving the process requires gathering more and better data and using it to measure performance and drive decisions.

In Michigan, the Transportation Asset Management Council (TAMC) provides independent, objective data on the condition of the state's roads and bridges. The council's dashboards measure performance on metrics that range from finance to safety on interactive road and bridge condition maps. TAMC also analyzes planned and completed road and

bridge investments and provides education and training on asset management principles.

Michigan lawmakers are working to implement a similar approach to manage the state's water infrastructure.

"Right now, we don't have the data to use the same process for drinking water, wastewater and stormwater," says Therese Empie, infrastructure strategic advisor to Michigan Gov. Rick Snyder.

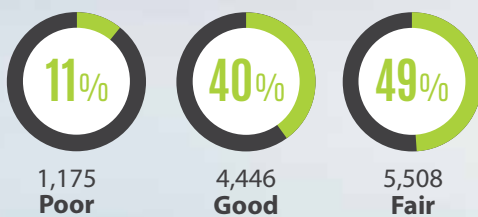
But recent legislation created the Michigan Infrastructure Council and the Water Asset Management Council, which will determine what data is needed and how to get it.

"We want to create an asset management culture by facilitating data collection that will allow local officials to articulate current asset conditions, where they want to get to and how they can get there," Empie says.

Colorado is also relying on data to improve its infrastructure project selection process. In 2017, CDOT created a chief data officer position to oversee this effort. The goal is to have life cycle data and real-time information on all assets.

## Michigan Bridges By the Numbers

Michigan's Transportation Asset Management Council provides independent, objective data on the condition of the state's roads and bridges. Below is the condition of the state's bridges in 2017.



Straits of Mackinac Bridge



# SECURING CRITICAL INFRASTRUCTURE

In the global arena, protecting critical infrastructure is a shared burden, with private and public entities each bearing some of the weight. In the face of mounting cyber attacks from criminal actors and nation-states alike, security depends on a combination of proactive collaboration, on the one hand, and predictive technologies on the other.

## PUBLIC-PRIVATE COLLABORATION

Government agencies and private entities possess complementary skillsets and competencies that can help protect vital infrastructure. Intelligence services and first responders can work with private enterprise to defend these critical assets.

Information sharing plays a key role, as private sector players share their real-time insights on physical and cyber threats with their government collaborators. In turn, those on the commercial side can benefit from briefings by entities such as the U.S. Secret Service and Federal Bureau of Investigation.

For such relationships to thrive, both sides must be sympathetic to the value of shared information. It takes trust and thoughtful navigation to seek out those areas of mutual benefit.

## PREDICTIVE TECHNOLOGY

As important as these collaborative efforts may be, they are just one side of the coin when it comes to safeguarding critical infrastructure. Government agencies also need predictive intelligence — technology tools that help them get in front of cyber threats.

Cisco's Umbrella continuously observes attackers' infrastructures to predict where threats will emerge. Umbrella gathers 100 billion internet requests from over 100 million enterprise and consumer users across 160 countries every day at the moment a request is made — giving Cisco data scientists and threat researchers a statistically significant data set and unique visibility on a global scale. Unlike behavioral analysis sandboxes, which have to wait for an attack to reach your networks to detect it, Umbrella prevents malicious connections from ever being made.

Driven by predictive intelligence, Umbrella complements existing security solutions by preventing malicious internet connections at the DNS and IP layers. Tools include reliable threat scoring and an alert summary, as well as up-to-the-minute views when a sudden spike in traffic indicates potential malicious activity.

Cyber attacks are all but inevitable and critical infrastructure sits squarely in the crosshairs of both criminal actors and rogue nation-states. Security requires a vigorous public-private collaboration, backed by the insights available through predictive defense tools.

FOR MORE INFORMATION, VISIT [HTTPS://UMBRELLA.CISCO.COM/USE-CASES/CRITICAL-INFRASTRUCTURE-SECTORS](https://umbrella.cisco.com/use-cases/critical-infrastructure-sectors).





# DEVELOPING MORE EFFECTIVE FUNDING & FINANCING







**F**or decades, traditional infrastructure funding mechanisms have not generated enough revenue to meet the nation's needs.

Consider traditional funding for water infrastructure. The most common way to pay for municipal water needs is a combination of rates paid by businesses and homeowners, and fees paid by developers of new properties to hook up to the water system. Rates are designed to cover operations and maintenance, while fees cover the cost of growth.

But in many cases, rate and fee revenue has been insufficient. The American Water Works Association (AWWA) projects it will take at least \$1 trillion to restore and expand existing drinking water systems over the next 25 years.<sup>10</sup> Paying for those needs could triple water bills for some households.

The story is similar for transportation infrastructure, where revenue from state and federal fuel taxes that fund road and bridge projects has been stagnant or decreasing.

For example, the federal tax on gasoline is 18.4 cents per gallon — a number that hasn't increased in 25 years, during which time it has lost at least 40 percent of its buying power to inflation.<sup>11</sup> Automobile fuel efficiency and the rise of hybrid and electric vehicles have further compromised the effectiveness of fuel taxes.

**“THE NEW SECOND AVENUE SUBWAY  
CREATED GREAT VALUE. WE NEED TO DO A  
BETTER JOB OF RECOUPING THAT VALUE.”**

- Patrick Foye, President, New York Metropolitan Transportation Authority

Funding was the No.1 concern among Governing Institute survey respondents. Forty percent of respondents cited “uncertain funding” — more than twice as much as any other option — when asked to list the greatest challenge to transportation planning.

Following are some considerations for state and local governments as they look at infrastructure funding options.

**Raise new revenue.** State and local governments are raising new revenue for infrastructure through broad-based tax increases, which appear to be gaining favor with voters, and narrower fees that technology has made easier to collect.

Over the past several years, voters have become more receptive to new taxes that improve the condition of transportation, water and energy assets. Since 2013,



A photograph of Shailen Bhatt, President of Intelligent Transportation Systems of America, speaking at a podium. He is a bald man with a mustache, wearing a dark suit jacket over a light blue striped shirt and a red undershirt. He is holding a microphone in his right hand and gesturing with his left hand. The background is blurred, showing what appears to be a conference or event setting with various posters and banners.

## “THE PUBLIC SECTOR HASN’T YET TAKEN A ROBUST ENOUGH LOOK AT HOW TO MONETIZE DATA.”

— Shailen Bhatt, President, Intelligent Transportation Systems of America

FLICKR/DENNIS SCHROEDER / NREL

28 states and the District of Columbia have enacted legislation that will increase or may increase overall state gas taxes.<sup>12</sup> And in 2016, voters approved 69 percent of transit-related ballot measures.<sup>13</sup>

Colorado will test that support with a November ballot measure that would raise the state’s sales tax by 0.62 percent to fund transportation improvements. Arguments in favor of the measure point out that Colorado’s road projects face a decade-long, \$9 billion backlog.<sup>14</sup>

The measure, spearheaded by the Denver Metro Chamber of Commerce, would direct 45 percent of the new revenue to CDOT, 15 percent to transit and multi-modal projects, 20 percent to cities and towns, and 20 percent to counties.

Spreading the benefits to various stakeholders should broaden support for the measure. And the fact that the business community, which is not usually a proponent of tax increases, is behind the measure marks a shift in the politics around infrastructure funding.

CDOT also worked with the State Transportation Advisory Committee to identify a priority list of projects that could be completed with the additional funding. Tyler Duvall, a partner with McKinsey & Co. who specializes in large capital and infrastructure projects, says this is an important practice.

“Identifying specific projects, specific time frames for delivery and including safeguards against cost overruns

are critical,” he says. “You can no longer just say, ‘We need more funding.’”

Other jurisdictions are implementing more targeted revenue generation efforts, often supported by new technology. For instance, electronic tolling systems make it possible to apply precise user fees to generate additional funds, and do so in a customer-friendly way. Vehicles can pay without slowing down and tolls can be based on vehicle miles traveled or other measures.

Tolling technology is also a tool for making more efficient use of transportation assets. Rather than building more highways or additional lanes to accommodate spikes in demand, congestion pricing — charging more during high-use periods and offering discounts at other times — can be used to encourage travelers to drive during off-peak hours.

For example, New York City is implementing a non-tolling form of congestion pricing by adding a \$2.50 fee to the price of a taxi ride and \$2.75 for those using transportation network companies like Uber and Lyft.<sup>15</sup> The revenue will be used to fund subway improvements.

The city also is among the jurisdictions working on value capture — directing part of the additional tax revenue generated by an infrastructure project to help pay for the project — though U.S. state and local governments have thus far achieved limited success on this front due to thorny questions such as where boundaries should be drawn for project beneficiaries and whether the



# Transforming Government Infrastructure Design

GOOD INFRASTRUCTURE starts with good design, backed by the right data. Some infrastructure projects involve scale and complexity that reach beyond the scope of many design tools and data systems currently used by state and local governments.

Advancements in three critical areas of infrastructure design can help public sector agencies build better projects faster – and at less cost.

## 1. Digitizing the Now with Reality Capture

Data on existing site conditions is an essential starting point for any design. Reality capture technologies such as 3-D laser scanning, mobile and aerial LiDAR, drone cameras and photogrammetry help agencies streamline the design process by reducing or eliminating return site visits and allowing them to capture data from existing conditions without disrupting people who are using the facilities.

## 2. Gaining Control of Design Data

Infrastructure design involves a vast and growing collection of data. But that data isn't always easily accessible to government design teams or the project's architects, engineers and contractors. Public sector agencies also need a way to collect and maintain the valuable knowledge held by experienced employees who are approaching retirement.

Best-in-class data management solutions include best practices to streamline data access, simplify project activity, free time for employees and ease collaboration for dispersed teams.

## 3. Maximizing Knowledge with BIM

The principles of building information modeling (BIM) can be applied to any built asset, including public infrastructure such as roads, bridges, water systems and utility lines. BIM software centralizes work plans and design documents for a construction project, helping everyone on the team easily coordinate work, facilitate schedules and reduce risk.

## Design Management Expertise for Government

The infrastructure of the future will transform communities – but only if state and local governments have the right knowledge and technology to build it.

The combination of IMAGINiT Technologies and DLT Solutions provides 20+ years of industry expertise in reality capture, data management and BIM. Beyond the government procurement process, we understand how design affects projects and can help government agencies define, integrate and optimize design processes. Whether you need help choosing the right solution for reality capture, data management or BIM, or if your team needs to improve its workflows, put our expertise to work for your organization.

Learn more at <https://www.imaginit.com/software/special-programs-offers/government>





beneficiaries should include homeowners whose property values have increased as a result of the project.

If these questions could be successfully addressed, a prime example of where value capture could be used is New York City's Second Avenue subway. The first phase of the project opened at the beginning of 2017 with three new stations along Manhattan's Upper East Side. Subsequent phases, which are subject to funding availability, would extend the line north to 125<sup>th</sup> Street in Harlem and south to Houston Street in Lower Manhattan.

"The new Second Avenue subway and the transit access it opened up created great value for property owners along that corridor," says Patrick Foye, president of New York's Metropolitan Transportation Authority (MTA). "We need to do a better job of recouping a portion of that value when the MTA builds major transit capital projects throughout the region in the future."

In addition, the MTA is a U.S. pioneer in using revenue from one transportation mode to help fund another. Excess toll revenue from MTA Bridges and Tunnels, the largest agency of its kind in the nation with seven bridges and two tunnels, helps fund MTA transit operations such as New York City subways and buses.

On the water side, credit support programs like the Water Infrastructure Finance and Innovation Act have been useful. The program accelerates investment in water infrastructure by providing long-term, low-cost

supplemental loans for regionally and nationally significant projects. It leveraged a \$17 million appropriation in 2014 to finance large (over \$20 million) projects and received an additional \$63 million infusion in March 2018.

Technology that allows infrastructure agencies to collect massive amounts of data also may open up new revenue possibilities.

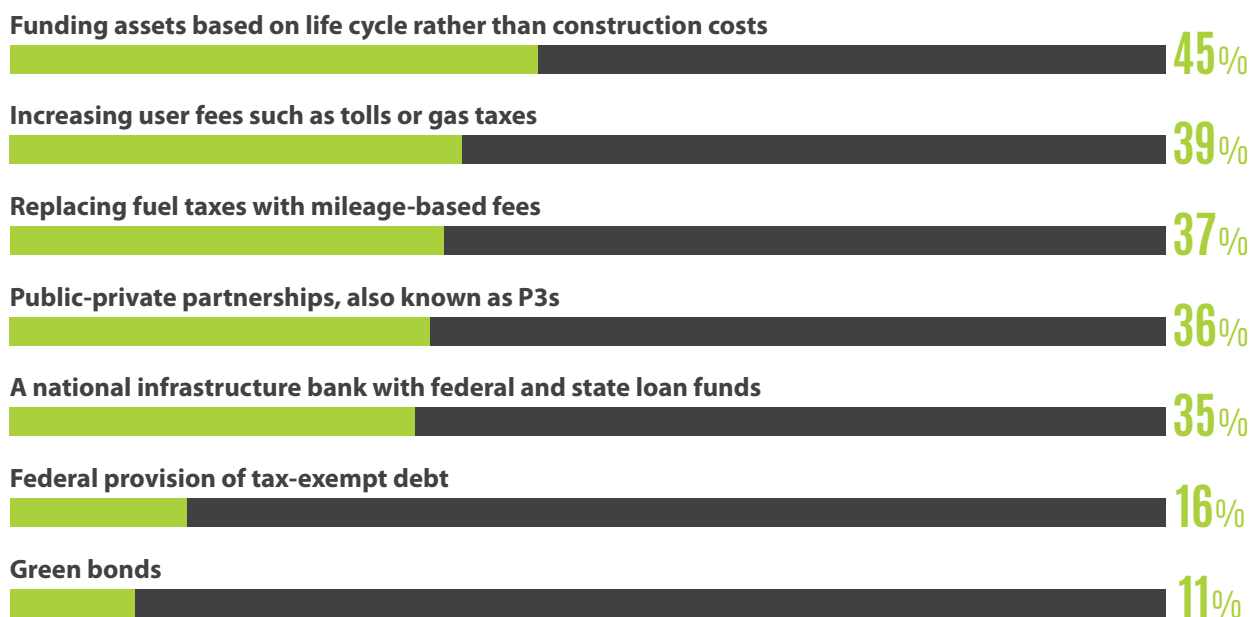
"The public sector hasn't yet taken a robust enough look at how to monetize data," says Shailen Bhatt, president of Intelligent Transportation Systems of America (ITSA). "It's generated by the public on public infrastructure and everyone seems to want it."

Granular information about driving conditions and roadway demand, for example, would be extremely valuable to logistics companies like Amazon, UPS or FedEx.

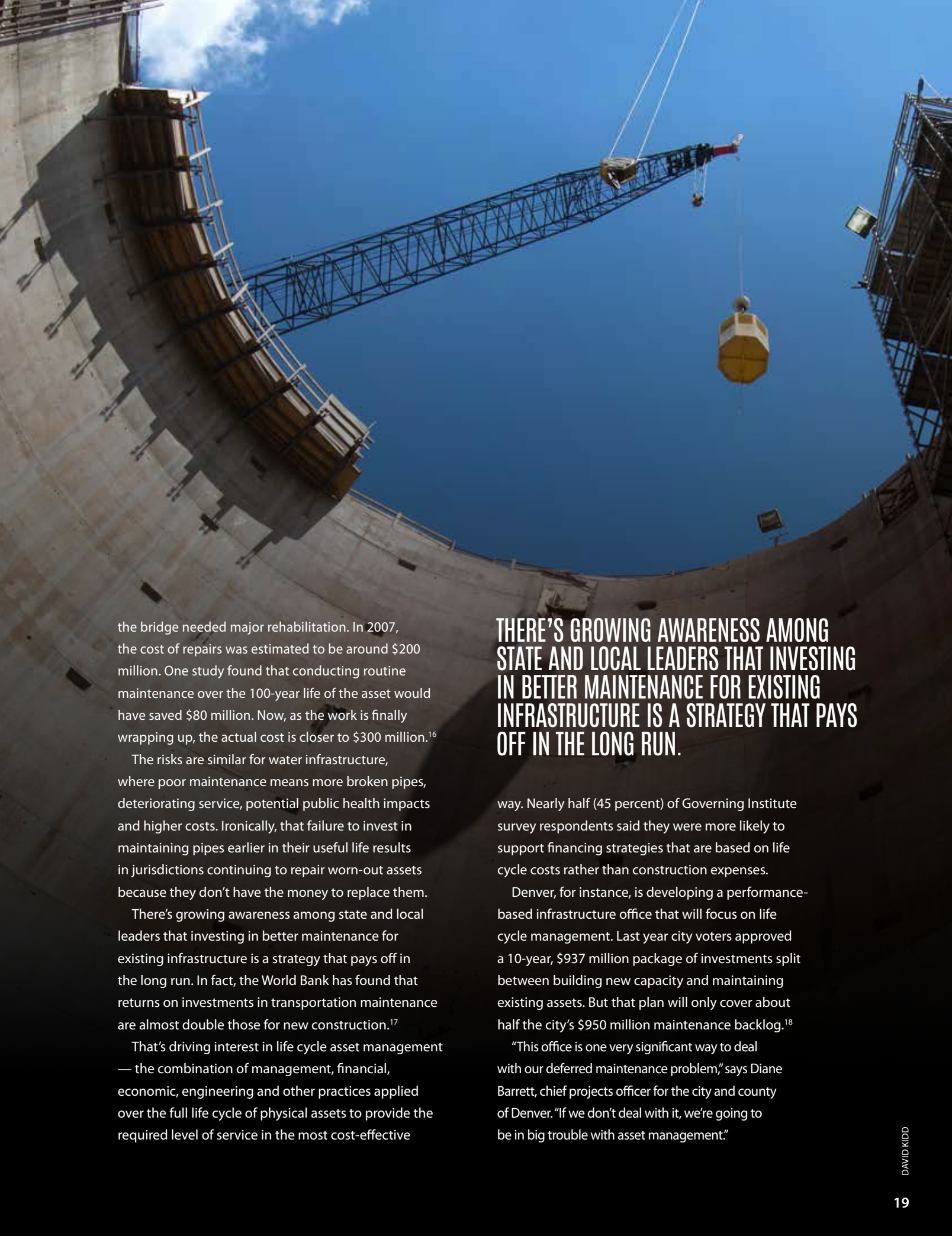
**Focus on life cycle costs.** Governments traditionally have based infrastructure investment decisions on what projects cost to build, without accounting for the cost of operating and maintaining an asset over its useful life. When money is tight, it's common for governments to defer upkeep on infrastructure since the impact isn't immediately apparent, but this is often far more costly than just maintaining assets over their life cycle.

Massachusetts' Longfellow Bridge, which spans the Charles River connecting Boston and Cambridge, provides a perfect example. After a century of neglect,

What financing strategies would you be most likely to support to fund infrastructure?







the bridge needed major rehabilitation. In 2007, the cost of repairs was estimated to be around \$200 million. One study found that conducting routine maintenance over the 100-year life of the asset would have saved \$80 million. Now, as the work is finally wrapping up, the actual cost is closer to \$300 million.<sup>16</sup>

The risks are similar for water infrastructure, where poor maintenance means more broken pipes, deteriorating service, potential public health impacts and higher costs. Ironically, that failure to invest in maintaining pipes earlier in their useful life results in jurisdictions continuing to repair worn-out assets because they don't have the money to replace them.

There's growing awareness among state and local leaders that investing in better maintenance for existing infrastructure is a strategy that pays off in the long run. In fact, the World Bank has found that returns on investments in transportation maintenance are almost double those for new construction.<sup>17</sup>

That's driving interest in life cycle asset management — the combination of management, financial, economic, engineering and other practices applied over the full life cycle of physical assets to provide the required level of service in the most cost-effective

## THERE'S GROWING AWARENESS AMONG STATE AND LOCAL LEADERS THAT INVESTING IN BETTER MAINTENANCE FOR EXISTING INFRASTRUCTURE IS A STRATEGY THAT PAYS OFF IN THE LONG RUN.

way. Nearly half (45 percent) of Governing Institute survey respondents said they were more likely to support financing strategies that are based on life cycle costs rather than construction expenses.

Denver, for instance, is developing a performance-based infrastructure office that will focus on life cycle management. Last year city voters approved a 10-year, \$937 million package of investments split between building new capacity and maintaining existing assets. But that plan will only cover about half the city's \$950 million maintenance backlog.<sup>18</sup>

"This office is one very significant way to deal with our deferred maintenance problem," says Diane Barrett, chief projects officer for the city and county of Denver. "If we don't deal with it, we're going to be in big trouble with asset management."



# Using Common Sense to Stretch Infrastructure Dollars

**When it comes to tools for meeting infrastructure needs,** don't underestimate the value of old-fashioned thrift. When bridges are taken down, for instance, contractors typically keep the beams and sell them back to public sector customers. Grant County Commissioner Cindy Bobbitt would have none of that.

"The taxpayers already paid for them once," she says.

So when an overpass on Interstate 40 was taken down, Bobbitt and others said they could reuse the beams, which generally account for about 10 percent of the cost of a bridge. Not only did Bobbitt get the beams for free, she persuaded the Oklahoma Department of Transportation to truck them about 100 miles north to Grant County, which ultimately used the material to build 16 new bridges.



DAVID KIDD

To address the deferred maintenance issue, some states have also enacted rules that require a better job of performing necessary maintenance. Utah prohibits the funding of new projects until at least 1.1 percent of the replacement cost of existing assets has been approved for capital improvements. In Missouri, the state's constitution requires that one percent of annual general fund revenues be placed in a maintenance reserve fund. Florida also gives existing assets priority when it comes to spending infrastructure dollars.

## **Make infrastructure assets more resilient.**

Governments will need to account for the growing impact of climate change as they make future infrastructure investments. The U.S. sustained \$300 billion in climate change-related damage in 2017 alone, and \$1.5 trillion in damage since 1980.<sup>19</sup> As is the case with maintenance, even though response and recovery efforts are far more expensive than prevention, several factors complicate efforts to make infrastructure more resilient, even in the era of climate change.

One is timing. Both governments and private equity tend to work on a three-to-five-year horizon for return on investment, and the return on investing in climate resiliency comes over a longer term. Another is the eternal problem of finding the necessary upfront capital.

Fortunately, a series of carrots and sticks may be combining to move state and local governments toward making the necessary investments. One carrot is the fact that, in some cases, the cost of preparing

for climate change can be minimal. The premium for making infrastructure more resilient can be as little as 0.5 percent, says Lisa Dickson, associate principal and director of resilience for the Americas at Arup. Return on that investment can come very quickly in the form of avoiding recovery and replacement costs.

On the stick side, proposed federal legislation would require jurisdictions to identify vulnerabilities and move to address them or risk a lower payout from the Federal Emergency Management Agency (FEMA) after a natural disaster.

In addition, Moody's and Standard & Poor's are considering how a jurisdiction's level of climate preparation might affect its overall bond rating. And the many jurisdictions that are vying to be home to Amazon's second headquarters surely have noticed that resilience is part of the company's criteria.

The need for resiliency has led some state and local governments to explore green infrastructure, which can be a more cost-effective way to address climate-change risks. In the last 80 years, the Mississippi Delta lost around 2,000 square miles of wetlands that could have reduced the \$200 billion worth of damage done by Hurricane Katrina in 2005.<sup>20</sup> Wetlands also recharge aquifers, provide recreational opportunities and have a longer useful life than built infrastructure.

Until recently, accounting practices prevented the benefits of green infrastructure from being realized at scale. But a clarification of Governmental Accounting



Standards Board Statement 62 now lets governments access capital programs and borrow to finance green infrastructure, provided a regulated entity with rate-setting authority can use that rate revenue to recover its investment. As a result, something can now be classified as an “asset” even if it isn’t owned and operated by government in the traditional sense.

This approach recently was employed in Washington, D.C., which, like many cities, has an outdated system that funnels storm water into the same pipes that handle raw sewage. On some days, heavy precipitation overwhelms the pipes, triggering the discharge of untreated sewage into local rivers.

To help ease flooding and sewage overflow, the district constructed a 13-mile-long, \$2.6 billion tunnel system beneath the city.<sup>21</sup> As part of the project, the agency installed green infrastructure — green roofs, porous pavement and rain gardens — throughout the city to capture stormwater runoff. To help fund the project, D.C. Water issued a 100-year, \$350 million green bond. It was the first time a so-called “century bond” has been issued by a municipal utility in the U.S.

**Take advantage of public-private partnerships.** Seemingly insurmountable infrastructure challenges make it critical for governments to attract private investment. When asked what financing strategies the public sector would be most likely to support, 43 percent of Governing Institute survey respondents selected public-private partnerships (P3s), more than any of the other six options mentioned.

State and local governments enter P3s to achieve goals that range from saving money to speeding project delivery to gaining access to private sector technology. In the transportation space there have been many agreements in which private entities have made large upfront payments that state or local governments couldn’t afford in return for the right to operate and collect toll revenue on a highway for a specific term.

Options are more limited for assets that don’t produce revenue, but availability payments have been used for non-revenue-producing assets. Under these agreements, private entities that design, build, operate and/or maintain an asset are paid based on the completion of specific project milestones or performance metrics such as lane closures or how they manage other incidents.

The survey results illustrate that P3s are becoming a more commonly accepted tool to address a range of infrastructure needs. State and local governments are

involved in many partnerships that reflect changes in both the infrastructure landscape and the role private entities can play in it.

In April 2018, the Los Angeles World Airports Board of Airport Commissioners approved a \$4.9 billion, 30-year P3 to design, build, finance, operate and maintain an automated people-mover system at Los Angeles International Airport (LAX). The contractor, LAX Integrated Express Solutions (LINXS), is a fully integrated consortium consisting of eight companies. The people mover is scheduled to become operational in 2023. It will move up to 10,000 passengers per hour, or 85.1 million annually, along a 2.25-mile elevated guide way stopping at every station (six in total) at two-minute intervals. This large, technically complex project is the centerpiece of a modernization plan for LAX to improve the guest experience and provide time-certain access to terminals.<sup>22</sup>

Other opportunities for mutually beneficial P3s have presented themselves in unexpected places. For instance, an energy company upgraded roads and bridges in rural Grant County, Okla., to facilitate the transport of massive turbine towers for wind farms being constructed in the area.

P3s need not refer solely to public-private partnerships. In fast-growing Aurora, Colo., Marshall Brown, the city’s director of water, has engaged in public-public partnerships aimed more at providing the city with access to land for reservoirs than finance. In return for siting a much-needed reservoir there, Aurora Water provides the host county with recreational benefits and access to the reservoir for storage.

**Gain efficiency through better coordination.**

Governments have traditionally operated in silos, with various agencies going about their work with little awareness of how they might coordinate with other agencies to save money and improve customer service.

Michigan is trying to change that. The state has hosted two Coordination and Communication Summits that bring together public and private utilities. The utilities submit their upcoming projects, which are all GIS mapped, then overlaid on top of one another. The goal is saving money and improving customer service through better coordination of the right of way. This allows the various entities to complete all needed work at once when a street is opened up, rather than subjecting local residents to multiple rounds of disruption and inconvenience.

# THE IMPACT OF NEW TECHNOLOGY

CHIPOTLE





**R**apid advances in technology offer both promise and a new layer of complexity when it comes to addressing the nation's infrastructure needs.

Nowhere in the infrastructure space is technology having a bigger impact than in transportation. Autonomous and connected vehicles will change the transportation landscape. Most experts forecast a move away from personal ownership of driver-guided vehicles over time and toward a "transportation as a service" model, even if autonomous vehicles don't replace those controlled by drivers anytime soon. At first, autonomous cars are likely to be in fleets of Uber-like on-demand vehicles.

These shifts will impact governments — and infrastructure planning and funding — in a variety of ways.

Population growth and the extension of mobility to people with disabilities, the elderly and adolescents could cause total miles driven to increase by as much as a quarter by 2040.<sup>23</sup> On the other hand, autonomous vehicles are expected to increase the capacity of current highways because the vehicles can travel closer together. Traffic flow also may be smoother due to fewer accidents.

Traditional transportation funding sources face uncertainty too. Gas tax revenues already have been

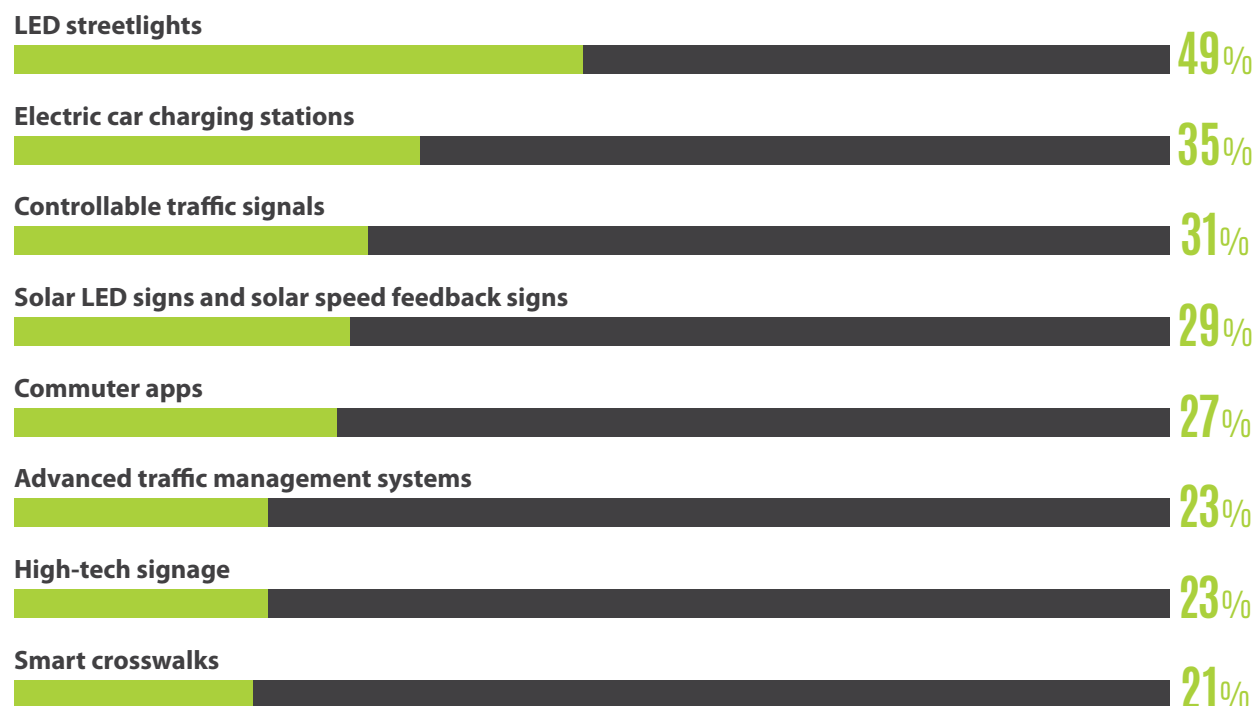
**POPULATION GROWTH AND THE EXTENSION OF MOBILITY TO PEOPLE WITH DISABILITIES, THE ELDERLY AND ADOLESCENTS COULD CAUSE TOTAL MILES DRIVEN TO INCREASE BY AS MUCH AS A QUARTER BY 2040.**

impacted by improving fuel mileage for conventional vehicles and growing popularity of electric vehicles. As autonomous vehicle technology goes mainstream, governments also are likely to see less revenue from parking fines and moving violations.

Public transit systems are another target for disruption. Some experts predict they'll lose market share to autonomous and connected vehicles that provide convenient door-to-door service, while others point to innovative partnerships between transit agencies and on-demand transportation services like Uber or Lyft that help riders reach their final destinations.

Recent transit trends aren't encouraging, with ridership often declining despite increases in overall transportation demand. The changing nature of work may be contributing to transit's woes. Intuit predicts

What intelligent infrastructure technologies does your organization plan to adopt in the next five years?



that by 2020, 40 percent of American workers will be freelancers who won't necessarily make a daily commute to an office.

Gone are the days when most jobs were downtown and commuters used a hub-and-spoke transportation system to reach them. Cities are responding with changes in transit design. For example, Houston reconfigured its bus system, going from a hub-and-spoke model to a grid system, and saw a 6.8 percent increase in ridership on its bus and light-rail systems in less than a year.<sup>24</sup>

### A PREMIUM ON PLANNING

Combine all these trends with the fact that technological change happens fast and the process of selecting, designing, building and operating new infrastructure is slow, and the result is unprecedented challenges for infrastructure planners.

"We're used to 30-year plans," ITSA's Bhatt says. But the fact is that we really don't know what to expect beyond 10."

The landscape will likely require multi-dimensional planning, under which infrastructure agencies will pursue different scenarios based on which course emerges. Until the future becomes clearer, flexibility

**WE'RE USED TO 30-YEAR PLANS. BUT THE FACT IS THAT WE REALLY DON'T KNOW WHAT TO EXPECT BEYOND 10."**

- Shailen Bhatt, President, Intelligent Transportation Systems of America

is crucial. Many agencies are leery of making big investments in legacy assets that could quickly become obsolete. McKinsey's Duvall says projects that already have been approved will generally continue and most that are far along in the stakeholder process, especially urban transit, will go forward.

"The thinking is that the return on investment will still be there, even if it's 10 or 15 percent less than previously thought," he says. "It's the next-generation projects that will be considered in light of the changing environment."

But the country can't afford to stand still. Bhatt suggests that even in a time of great uncertainty about the future, there are important investments to be made. He points to airport modernization and technology infrastructure such as wireless connectivity and sensor networks that collect data for performance management.

## Smart Sewers in South Bend

**Transportation isn't the only area in which new** technology is making a major impact. South Bend, Ind., uses wireless sensor technology to improve the capacity of existing sewer infrastructure.

In 2004, the EPA ordered the city to prevent its combined sewage and storm drain system from spilling sewage into the St. Joseph River during rainstorms. City officials initially estimated remediation would cost \$860 million, but now they're using technology to reduce that amount.

Today, internet-connected sensors mounted on 150 manholes broadcast water-level data every five minutes. The sensors also can open and close valves in the sewer system, directing wastewater into pipes where capacity is available.<sup>25</sup>

Besides potentially saving hundreds of millions of dollars, the sensor network has eliminated about a billion gallons of annual sewage flow into the river since it was installed in 2008. It also enabled the city to implement a data-driven maintenance and cleaning program, which has improved sewer system performance.



# Real-World AI is Here.



**A**s state and local governments look to strengthen and improve their physical infrastructure, they must ensure their IT infrastructure is up to par as well.

Advances in deep neural networks have ignited a new wave of applications for artificial intelligence (AI). Powerful new tools and techniques have enabled breakthroughs in fields like self-driving cars, natural-language translation and predictive health care. But AI requires a completely new IT infrastructure, and its complexities can hold agencies back from moving into the new era of intelligence.

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A photograph of a rusty metal structure, possibly a bridge or industrial framework, with several birds nesting in it. The structure is made of weathered steel beams and plates, showing significant rust and wear. In the center, a bird with dark plumage and a reddish-brown head is perched on a ledge, facing right. To its left, another bird is partially visible, and further back, a third bird is seen. The background is a soft-focus view of green foliage and trees. The overall tone is somewhat somber due to the rust and the industrial setting.

# OVERCOMING REGULATORY BARRIERS



**A**s Shailen Bhatt says, “Nobody wants regulation — until a building collapses.”

The key is to develop a regulatory scheme that protects public safety and other important interests without unduly hampering infrastructure development. But accomplishing this is a tough balancing act — and government leaders can feel their efforts are stymied by bureaucratic tape. One-third of Governing Institute survey respondents said regulatory barriers keep their jurisdictions from modernizing infrastructure.

Mckinsey’s Duvall points to the fact that building in the U.S. is more complicated than anywhere else in the world.

“There are environmental regulations, lots of stakeholders, planning prerequisites for getting federal money and the fear of litigation hangs over the whole process,” he says.

To make things even more difficult, the public sector is usually required to use a low-bid process that prohibits value-based procurement.

The effects of regulation can be felt across infrastructure categories. Aurora Water’s Brown cites a lack of coordination among state and federal regulatory processes. Siloed regulation around the Clean Water Act, for example, doesn’t account for how those decisions impact the Safe Drinking Water Act. In addition, he says, water scarcity exacerbates regulation-related problems in Western states.

“You shouldn’t look at wastewater in isolation,” Brown says, “because we need to reclaim that wastewater, purify it and repurpose it for drinking water.”

Cindy Bobbitt cites two regulatory barriers that affect her efforts to maintain Grant County’s roads and bridges, although one is improving. The Migratory Bird Treaty Act of 1918 can shut down bridge projects between March 1 and August 31, because netting is required to work

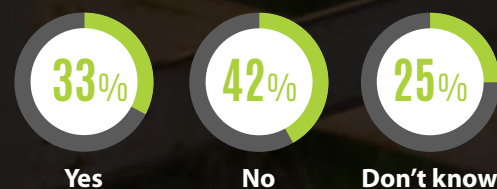
on the bridges if barn swallows are present. A few years ago, flooding took out the netting under several of the county’s bridges. While county employees were able to replace the netting after the flood waters receded, it created delays and added costs to the projects. Bobbitt says the barn swallows can also prevent work from starting on a bridge that needs to close.

Some of what makes it difficult to build things in the U.S., like the right of stakeholders to have input in the process, are simply the price we pay to live in a democracy. But there are ways to reduce the degree to which regulations serve as a barrier to modernizing infrastructure.

Other governments could learn from Michigan’s Coordination and Communication Summits and create a process that allows agencies to understand the broader impact of their actions before issuing new regulations.

Developing regulations that focus more on outcomes than process would also help. Holding utilities and state and local government agencies accountable for outcomes gives those entities the autonomy to achieve results in a way that doesn’t conflict with other aspects of their work.

Are there regulatory barriers that keep your jurisdiction from modernizing infrastructure?







# CONCLUSION

America's infrastructure needs are overwhelming, and delay in addressing them will only make these challenges exponentially bigger — and more expensive. Infrastructure systems are interconnected. If power systems fail, the water supply dries up and the technology that is becoming ever-more present on roads and bridges won't function, all with devastating results.

As state and local governments make infrastructure decisions, leaders should remember that rehabilitation and recovery are far more expensive than prevention. Assets must be resilient and properly maintained.

Choosing which assets to invest in has never been more complex. New technologies like autonomous and connected vehicles, combined with societal changes in the nature of work, make it difficult to know what the future will look like. Those changes are happening fast, while choosing new infrastructure projects, planning them, acquiring

the funding, obtaining regulatory approvals and constructing them is a very slow process. These realities put a premium on planning to avoid making big investments in obsolete assets.

Flexibility is critical until the future becomes clearer. The useful life of many physical infrastructure assets is long; it's imperative that we build them to meet tomorrow's needs, not those of yesterday or today.

The challenge is daunting, but technology provides us with new and valuable tools to address it, including customer-friendly ways to raise revenue. Another valuable asset is growing public awareness of the importance of infrastructure and the need to invest in it, as demonstrated by the frequency with which voters are approving measures to raise more money for transit and the number of states that are increasing infrastructure-related gas taxes and vehicle fees.

We have a lot of work to do. The time to start is now.



# Delivering Innovative Solutions

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## MAKING PBI HISTORY IN DENVER

The city of Denver had the third-highest growth rate among cities of more than 500,000 people between 2010 and 2017, according to the U.S. Census Bureau. To manage its associated infrastructure challenges, the city and county of Denver tapped Arup to create a Strategic Municipal Performance-Based

Infrastructure (PBI) program and PBI Office — one of the first such municipal programs in the United States.

Based on national and international best practices, the new model will help the city systematically identify and deliver projects where alternative procurement may deliver better value to the city and its taxpayers. The new framework complements Denver's existing approach to finance while giving city officials a more thoughtful, transparent way to determine when it makes sense to work with private sector partners and how to structure and manage those partnerships. The program will help the city meet rising demand for infrastructure developments and improvements as Denver continues to experience unprecedented growth.

# ARUP

For more information on how Arup can help your city or municipality deliver innovative infrastructure solutions, visit <https://www.arup.com/expertise/services/advisory-services>, or contact Orion Fulton (Orion.Fulton@arup.com) and Brian Swett (Brian.Swett@arup.com).

# GOVERNING

I N S T I T U T E

The Governing Institute advances better government by focusing on improved outcomes through research, decision support and executive education to help public-sector leaders govern more effectively. With an emphasis on state and local government performance, innovation, leadership and citizen engagement, the Institute oversees Governing's research efforts, the *Governing* Public Official of the Year Program, and a wide range of events to further advance the goals of good governance.

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## ENDNOTES

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An abstract graphic on the left side of the page. It features a dark background with a network of purple lines and dots, resembling a data mesh or a road layout. Several translucent, glowing car shapes in yellow, cyan, and purple are positioned along these lines, suggesting movement or data flow.

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